



GBM Instrument Operations Center Overview & Management

SDR Section 16

W. Paciesas/Rob Preece



Outline

► ***GBM IOC Management – W. Paciesas***

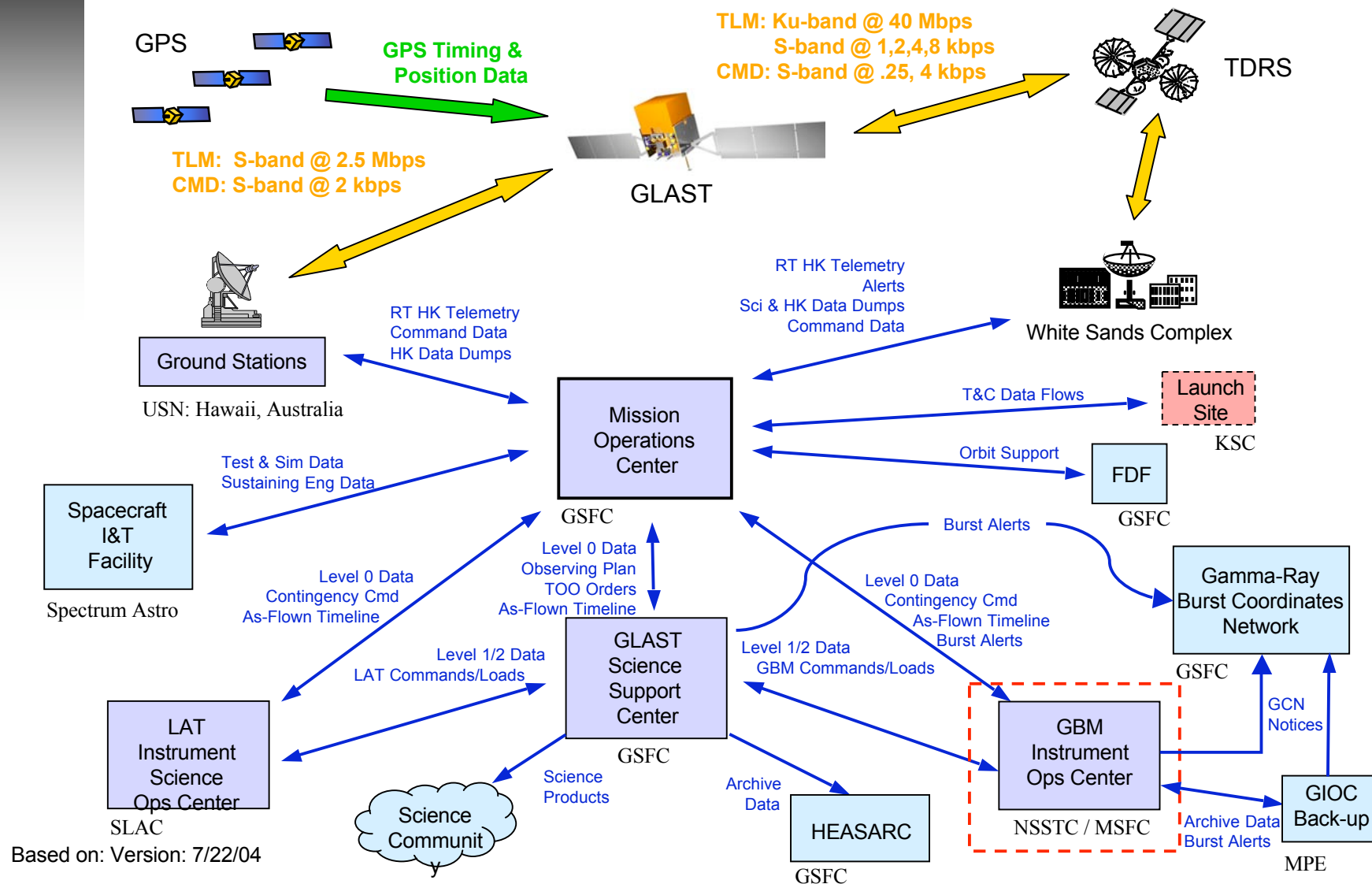
- *Intro*
- *Review History*
- *IOC Requirements*
- *Organization*
- *Security*
- *Schedule*

► ***Technical – Rob Preece***

- *Software Requirements*
- *Design Changes and Drivers*
- *Release Schedule*
- *Data Flow*
- *Process Plan*
- *Testing*
- *Level of Effort*



Major Interfaces – GIOC



Based on: Version: 7/22/04



GIOC Review History

- ▶ ***GBM System Requirements Review: [January 2001](#)***
- ▶ ***GBM Ground System Preliminary Design Review: [April 2003](#)***
- ▶ ***GLAST Ground System Requirements Review: [July 2003](#)***
- ▶ ***GBM Ground System Critical Design Review : [Oct 2003](#)***
- ▶ ***GBM System Critical Design Review : [June 2004](#)***



RFA Status



<i>Number</i>	<i>Initiator / Actionee</i>	<i>Subject</i>	<i>Action</i>	<i>Status</i>
GSEC-001	McCall / Diehl	No reference to the GBM Ground Software SDP in the Test Plan	Ground Software Test Plan has been changed.	Closed
GSEC-002	Rackley / Connaughton	Complete Requirements Traceability	Flow-down completed from the GSRD and MSS to the RVC.	Closed
GSEC-003	Rackley / Preece	Level 1 Data Product Generation Approach (24 hr data latency)	Wrote new requirements for GSRD that separated latency requirements between continuous and trigger GBM science data.	Closed
GSEC-004	Rackley / Preece	Handling Time Parameter Rollover (Project Epoch too early: GBM time will roll over)	Level 1 Data Products will not contain GBM-formatted time. MOC will have to correct time for ITOS displays.	Closed
GSEC-005	Rackley / Paciesas	Handling Telemetry Arrays in AstroRT and ITOS	ITOS will handle arrays in subsequent releases. (AstroRT will not.)	Closed
GSEC-006	Preece / Preece	BAP Handling of LAT Burst Alerts	LAT-GBM ICD specifies the format of the LAT Alerts in sufficient detail for the BAP.	Closed



GIOC Documents Summary



Document	Doc. Lead	Status
GBM-REQ-1007 System Requirements Database	F. Berry	Baselined
GBM-PLAN-1022 Ground Systems Plan	W. Paciesas	Baselined
GBM-PLAN-1023 Ground Software Development Plan	R. Preece	Baselined
GBM-SPEC-1025 Simulation/Detector Response SW Functional Spec	M. Kippen	Baselined
GBM-SPEC-1031 IODA Functional Spec	R. Preece	Baselined
GBM-SPEC-1036 GBM Ground Software Architectural Design	R. Preece	Draft
GBM-PLAN-1037 GBM Ground Software Test Plan	R. Diehl	Draft
GBM-PLAN-1038 GBM IT Security Contingency Plan	W. Paciesas	Draft



Overview: GIOC



► **Functions:**

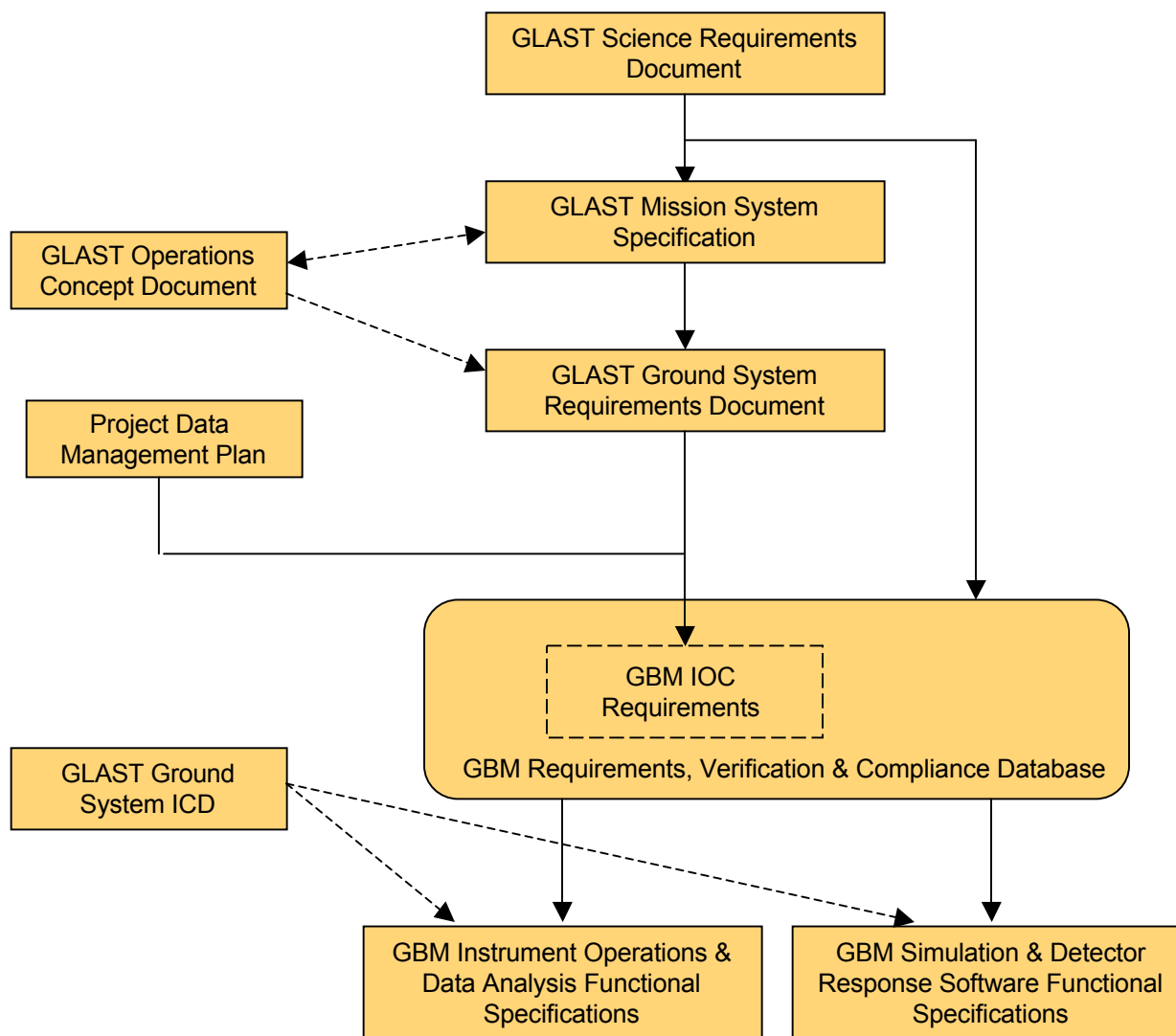
- *Generate, archive & distribute level-0/1/2/3 data products*
- *Instrument commanding*
- *State-of-health monitoring*
- *Support instrument calibration*
- *Validate flight data*
- *Quick-look science data analysis*
- *Generate rapid science alerts*
- *Refine burst alert processing*
- *Maintain flight software development system*
- *Maintain IODA software, including Burst Alert Processor*

► **Implementation:**

- *Located at NSSTC, Huntsville, AL*
- *Cluster of ~3 COTS Linux workstations*
- *1 TB+ RAID Archive*
- *1 Large-Screen Monitor*
- *Normal staffing weekday prime shift*
- *Supplemental operations at Max Planck Institute (MPE)*
- *Basic data receipt, data reduction & state-of-health monitoring run autonomously*
- *GSSC back-up for level-1 data processing*
- *GIOC provides BAP to GSSC for production of rapid science alerts*
- *GIOC maintains BAP back-up at NSSTC*



GIOC Requirements Flowdown





GIOC Key Requirements (1)

► ***Instrument Monitoring***

- *Instrument performance & anomaly analysis*
- *Generate Summary Reports*
- *Maintain Operations Log*

► ***Instrument Commanding***

- *Develop Command Loads*
- *Schedule Commands*
- *Develop Contingency Procedures*

► ***Data Processing***

- *Generate & Archive Level 1 Data Products*
- *Generate & Archive High-Level Science Products*
- *Support Data Processing/Reprocessing Rate > 2 X Orbit Average Data Production Rate*
- *Maintain Archival Data Storage Capability > 4 TB*



GIOC Key Requirements (2)

- ▶ ***Generate Ground-Based Burst Locations (Rapid & Final)***
- ▶ ***Provide Data to & Acquire Data from GBM Mirror Site***
- ▶ ***Respond to GBM Trigger Alerts***
 - *Perform Standard Analysis*
 - *Generate GCN messages as appropriate*
- ▶ ***Monitor Instrument Calibration***
 - *Process & Archive Test & Calibration Data*
 - *Monitor Detector Gain & Resolution*
 - *Generate Detector Response*
 - *Deliver Calibration Data to GSSC*
- ▶ ***Support Science Data Analysis***
 - *Develop & Maintain Data Analysis Software*
 - *Deliver Data to MPE*
 - *Deliver Data to GSSC*

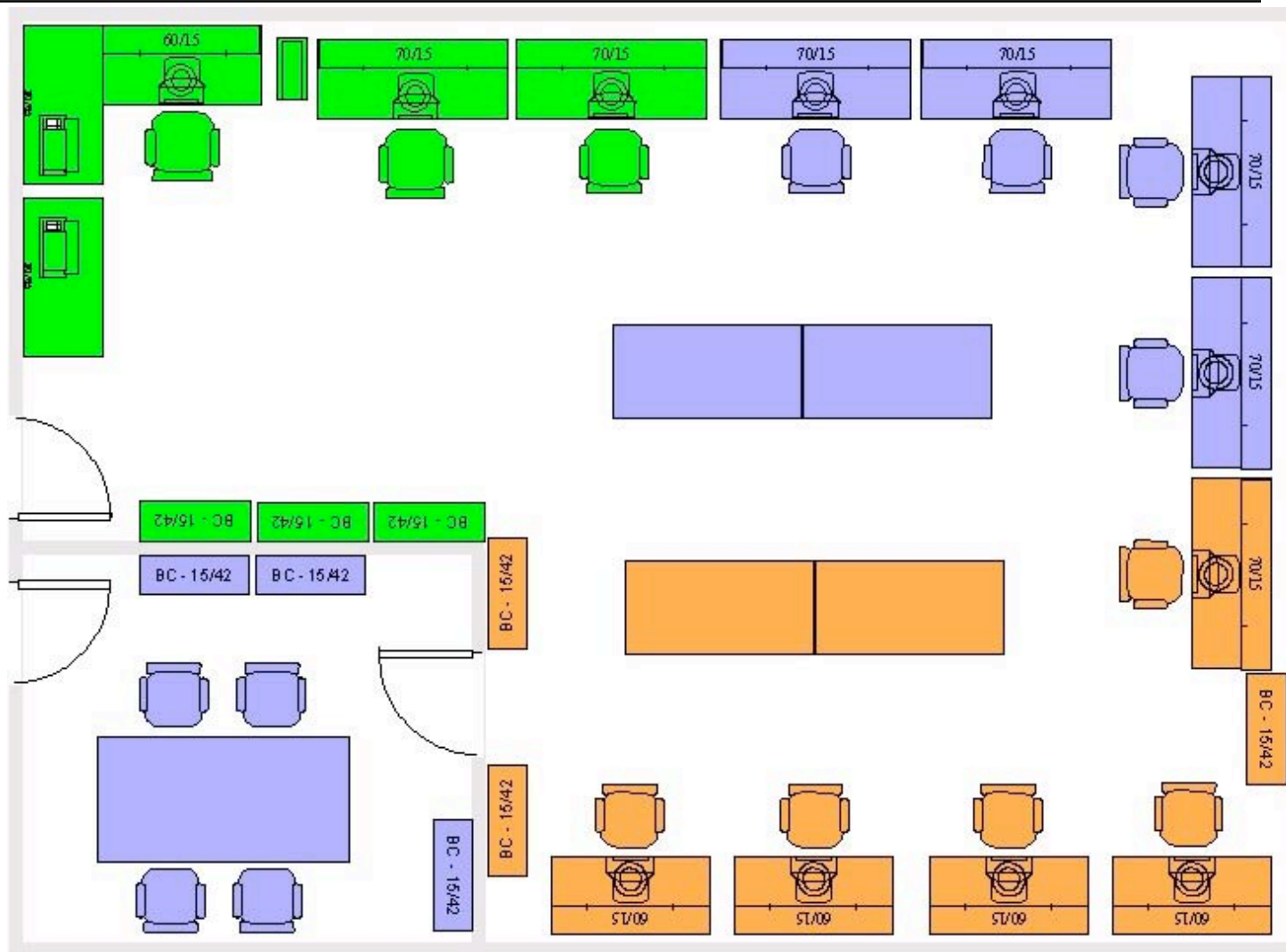


GIOC Key Requirements (3)

- ▶ ***Maintain Flight Software***
 - *Validate Flight Software Loads*
 - *Generate Flight Software Uploads*
 - *Maintain Flight Software Simulator*
- ▶ ***Perform Operations***
 - *Schedule Routine Operations*
 - *Support Capability for On-Call Operations*
 - *Support Special Operations During On-Orbit Activation*
 - *Provide Capability for Autonomous Data Receipt*
- ▶ ***Evaluate and maintain the quality of science data***
- ▶ ***GIOC available for autonomous data transfers from the MOC > 90%***
- ▶ ***Connect to Other Operations Elements by Secure Network***
- ▶ ***Verify/Validate Data by Visual Inspection & Analysis***



GIOC Facility Layout



NSSTC Room 2100/2101

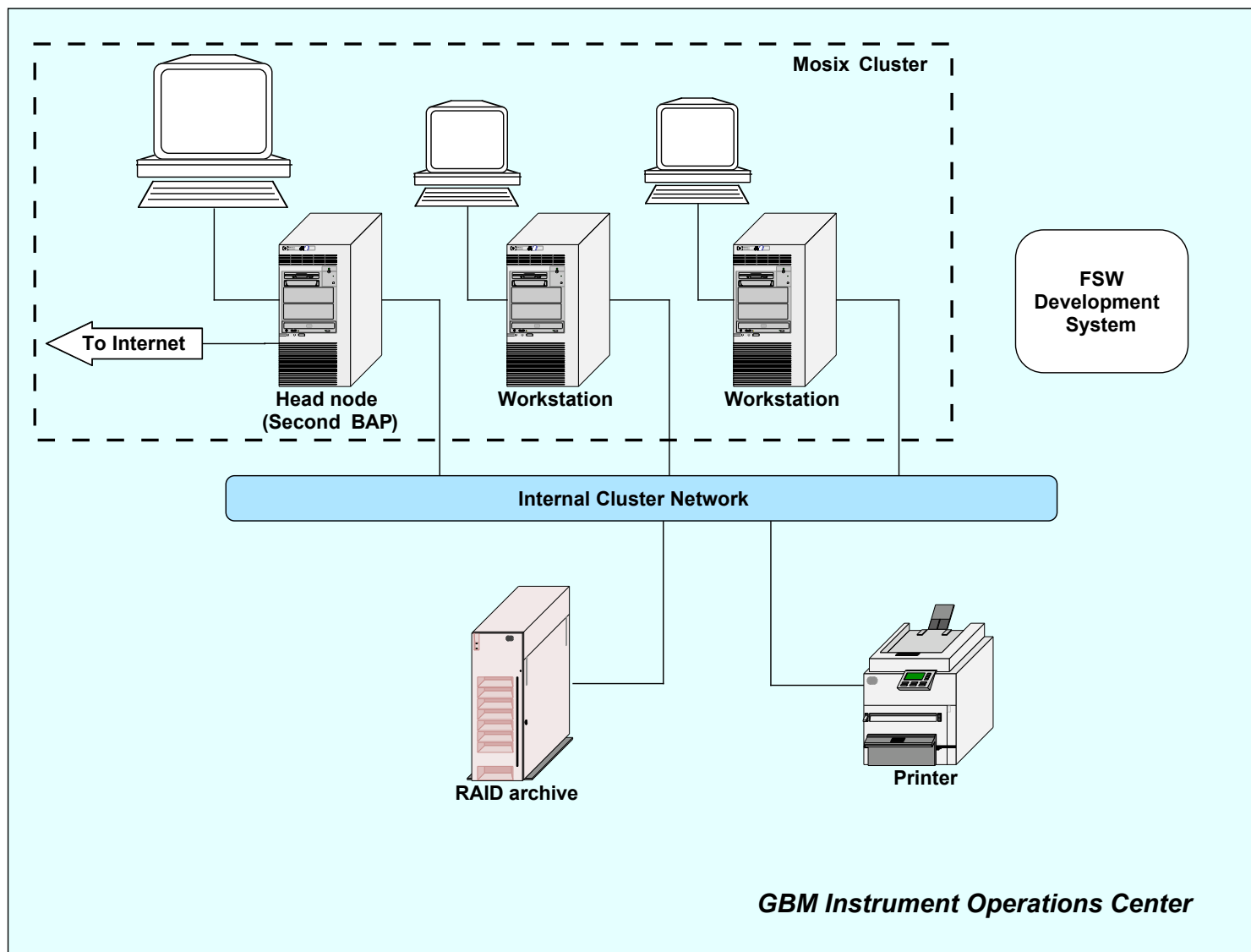
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GLAST Ground System Design Review August 18&19, 2004



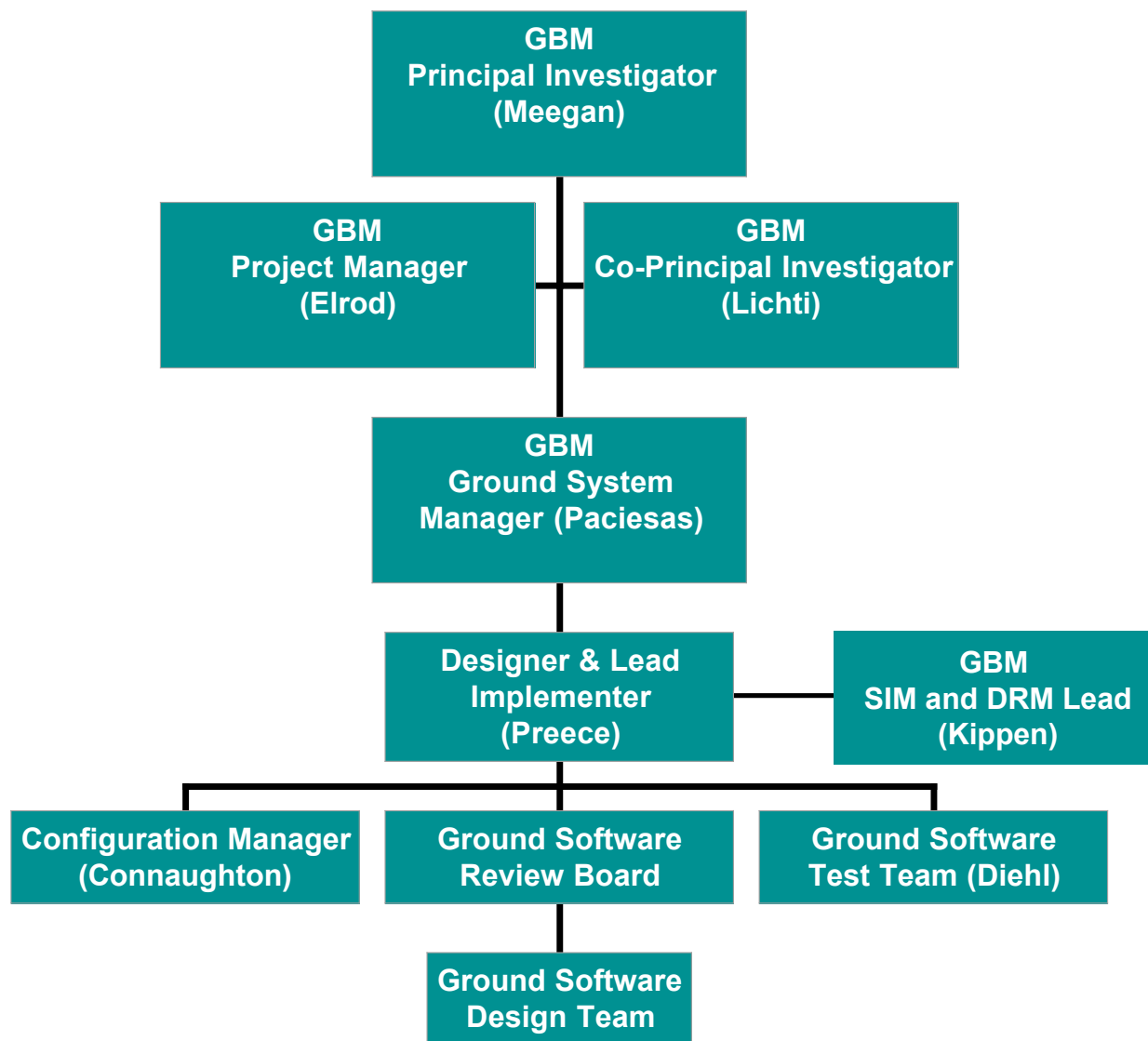


GIOC Network/Architecture





GIOC Development Organization



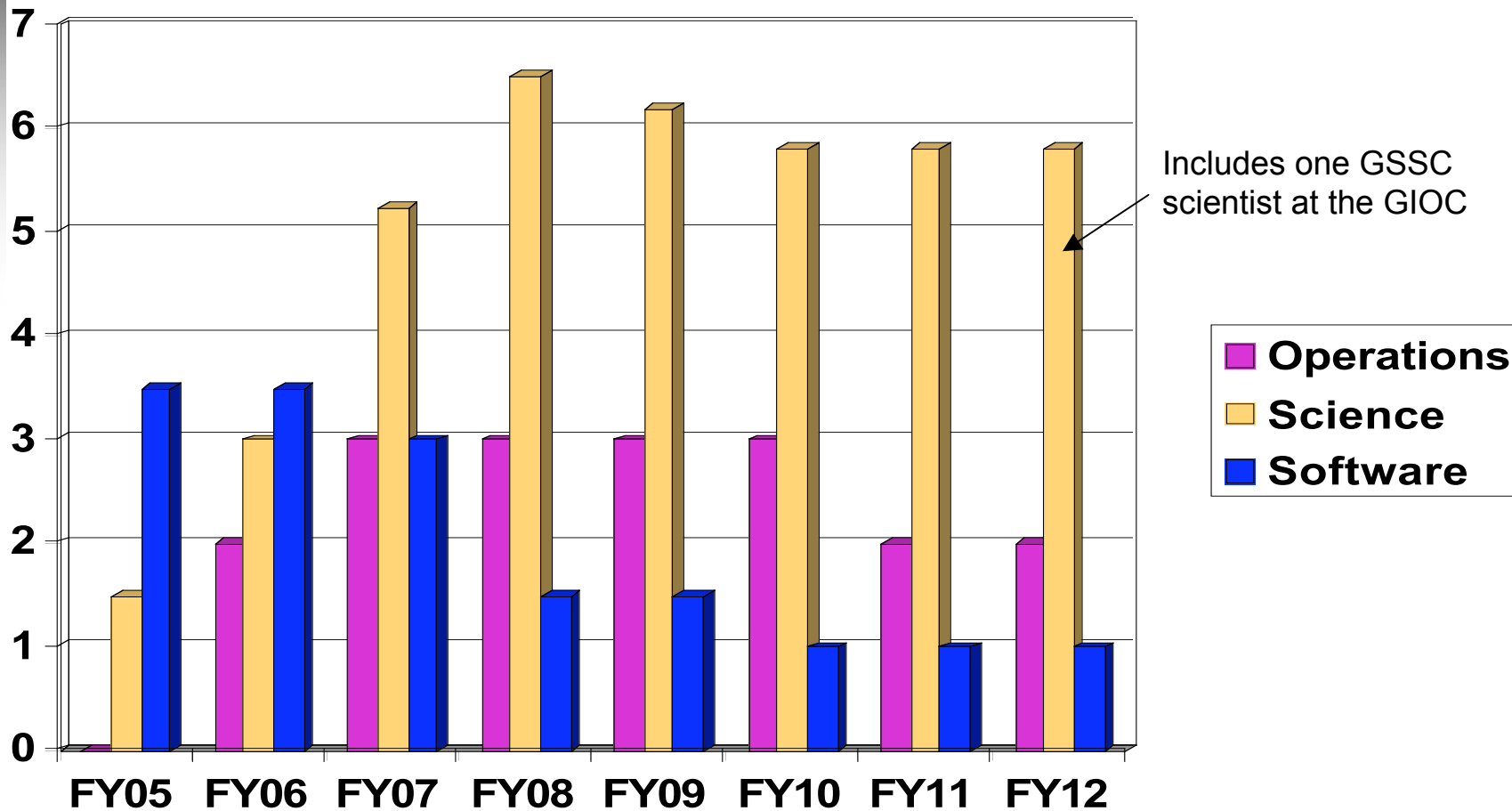


Roles & Responsibilities

Team or Individual	Tasks
GBM Project Manager (Elrod)	Overall Experiment Management
GBM PI (Meegan)	Overall Scientific Management
GBM Ground System Manager (Paciesas)	Management of Ground System Development & Operation
Ground Software Review Board (Chair – Preece)	A subset of the Ground Software Design team with decision-making authority
IO/DA Software Lead (Preece)	Designer and Lead Implementer of the Ground Software Development
GBM SIM and DRM Lead (Kippen)	Designer and Lead Implementer of the GBM Simulation and Detector Response Software
Configuration Manager (Connaughton)	Assure that all software deliverables are archived, properly identified, and retrievable
Ground Software Design Team (Chair – Preece)	Review the design, both at informal walk-throughs, and as presented in the detailed design document.
Ground Software Test Team (Chair – Diehl)	Review the Ground Software Test Plan. Develop test procedures. After review, perform the tests and prepare the test reports.



GIOC Staffing





GIOC IT Security & Contingency Plan

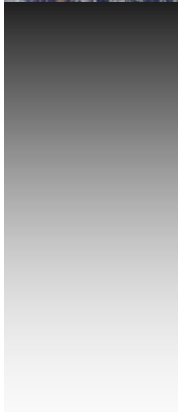


► **Security**

- *NSSTC security plan implements NPG 2810.1*
- *Access to MODAF is restricted via keycard*
- *No direct commanding from GIOC*
- *Links to MOC & GSSC will be secure*

► **Contingency**

- *GSSC back-up for level-1 data production*
- *Primary archive is RAID system*
- *Back-up archive on DVD & stored off-site*
- *Essential state-of-health monitoring is done by MOC; additional instrument monitoring from any internet access point via ITOS display server*
- *MOC can execute PROCs with approval from the GIOC*
- *System is required to re-process data at > 2X orbit-average on-board data production rate, so data production pipeline can catch up after interruption*





GIOC Data Analysis Summary

Rob Preece

UAH



Major GIOC Requirements

- ▶ *From the GBM Requirements, Verification & Compliance database (RVC: GBM-REQT-1007)*
- ▶ *Packet Data Handler: 3.7.2.2.1.1 Level-1 Data Processing*
- ▶ *Trigger Data Packager: 3.7.2.2.2.1 Spectral History Files & 3.7.2.2.2.2 Detector Response Matrices (SIM/DRM effort)*
- ▶ *Data Display: 3.7.2.2.1.4 Housekeeping and Status Data Processing & 3.7.2.1.1.3 Detector Rate Monitoring*
- ▶ *Calibration History: 3.7.2.1.1.5 Detector Spectral Analysis & 3.8.6. Instrument Calibration*
- ▶ *Command Load Handling: 3.8.13.1 Communications format and protocol*
- ▶ *Data Analyses: 3.1.2.3 Trigger Characterization Data & 3.8.7.1. Data analysis software*
- ▶ *Spectral Analyses: 3.7.2.2.1.9 Spectral Deconvolution, Including Detector Response Simulation (SIM/DRM effort)*
- ▶ *Trigger Catalog (3.7.2.2.2.3)*



Design Changes: Data Flow Pipeline

- ▶ **Processing Level 1 science data requires both Level 0 GBM Science & GHK data**
 - Design of DPU: “hands-off” science data accumulation
 - GHK Contains data quality flags
 - GHK not synched to Science data
- ▶ **Accommodate Best GSSC Archiving Design: 24 hr slices of GBM Level 1 continuous data**
 - RFA GSEC-003 lead to the creation of a new requirement in the GSRD
 - Good latency margin: ~10 min. typical vs. 24 hrs. (requirement)
- ▶ **GBM Trigger data has original 24 hr latency: typical latency depends upon phasing of trigger data across passes, but at most 1 extra pass (~4 hr.)**
- ▶ **Retransmission of ‘gap’ data from MOC requires minor reprocessing of Level 1 data files**
 - Normal gaps to be filled in place; whole Level 1 file not reprocessed
 - Version number of Level 1 data files increased; each new file must be retransmitted whole to GSSC



Design Changes: BAP Design

- ▶ ***BAP will be located at & maintained by the GSSC***
- ▶ ***Co-located with the GCN (if power to BAP goes down, so does the GCN)***
- ▶ ***BAP will also process LAT Burst Alerts (RFA GSEC-006: as defined in the LAT-GBM ICD: 433-ICD-0001)***
- ▶ ***BAP will ignore repeated packets for a given trigger (needed by GLAST SC for fastest access to TDRSS DA channel)***
- ▶ ***BAP will send a keep-alive message to the secondary BAP at the GIOC every 5 s.***
 - *Secondary BAP will take over if there is a HW/SW failure of the Primary BAP*
 - *Minimal delay for maximal science return*
 - *Protocol: very minimal exchange of token*
- ▶ ***BAP Architecture:***
 - *perl script front end for formatting GBM & LAT on-board localizations*
 - *Reusable, flexible C / C++ code for on-ground localizations using subsequent GBM Burst Alerts and Science Data*



Design Changes: GBM Commanding

- ▶ ***Telemetry & Command (T&C) Database for FSW Build 1 is in place***
- ▶ ***Command Messages from GIOC to GSSC & MOC have (at most) two parts:***
 - *Header file: contains metadata, PROC or binary file name*
 - *Header file format has been chosen: FITS*
 - *MOC, GBM, & GSSC all have experience with FITS*
 - *Keywords for Command Header file are being coordinated with the MOC-GSSC Working Group*
 - *Binary file (optional): upload image, raw commands & params*
- ▶ ***Use of ITOS for PROC development; Command validation***



Overview: SIM/DRM

- ▶ **Description:** *SIM/DRM == simulation software and detector response models to compute how GBM responds to gamma-ray bursts*
 - *Required to analyze all GBM science data*
 - *Resulting data will be incorporated into the GBM IODA software system*
 - *S/W and models will be verified against three levels of GBM calibration data*
 - *SIM/DRM developed at LANL in collaboration with IODA developers*
- ▶ **Primary Deliverables:**
 - *GRESS == GBM Response Simulation System software package*
 - *Computer mass models of GBM detectors, GLAST spacecraft, and Earth atmosphere*
 - *Production detector response matrix (DRM) database*
- ▶ **Reviews:** *SIM/DRM documentation and design was reviewed at*
 - *Ground Software System PDR (Apr., 2002)*
 - *Ground Software System CDR (Oct., 2003)*



Design Changes: SIM/DRM Status



► ***SIM/DRM development is affected by:***

- *Delivery of GBM detector design data/drawings (received June 2004, three months behind original schedule)*
- *Delivery of GLAST spacecraft design data/drawings (partial delivery Aug. 2004, five months behind original schedule)*
- *Schedule of GBM calibrations*
 - *Required to verify SIM/DRM s/w and models*
 - *Detector level (MPE), system level (NSSTC), spacecraft level (Spectrum)*
— *all slipped due to launch slip.*

► ***Development status:***

- *Preliminary versions of GRESS software complete (several months ahead of schedule)*
- *Detector model development starting now (3 months behind)*
- *Result: able to meet required delivery schedule*



Major Software Design Drivers

- ▶ ***Small development team***
- ▶ ***Reuse of existing software, where possible***
- ▶ ***Three stages of deployment; three different purposes:***
 - *EGSE; GBM System Integration and Testing (I&T)*
 - *GSIS; Observatory I&T*
 - *Instrument Operations and Data Analysis*
- ▶ ***Modular components for developed software:***
 - *Maximal reuse across operating systems*
 - *Maximal reuse across deployment phase*
 - *Autonomous operation w/out graphical user interface*
- ▶ ***Observatory-wide data format standards: FITS and CALDB***
- ▶ ***Simple commanding architecture:***
 - *FITS Command wrapper*
 - *ITOS PROCs in ASCII*
 - *ITOS binary file and table uploads*



Data Products

- ▶ **Level 0 from MOC:** (MOC-IOC ICD 492-MOC-009)
 - ▶ **GBM Science**
 - *CTIME, CSPEC & TTE*
 - ▶ **GBM Housekeeping**
 - *GHK; currently 10 APIDs*
 - ▶ **Diagnostic telemetry**
 - *Mostly FSW messages*
 - ▶ **Memory & LUT dumps**
 - ▶ **Burst Alert Messages**
 - *Stored in SSR HK partition, as well as being sent immediately*
- ▶ **Level 1 to GSSC (FITS):** (GSSC-IOC ICD)
 - ▶ *CTIME & CSPEC - daily*
 - ▶ *GHK - daily*
 - ▶ *CALDB (gain & position histories daily)*
 - ▶ *CTIME & CSPEC - trigger*
 - ▶ *TTE - trigger*
 - ▶ *TRIGDAT (from Burst Alerts) - trigger*
 - ▶ *DRMs - trigger*
- ▶ **Level 2 to GSSC (FITS):**
 - ▶ *Trigger Catalog Entry*
 - ▶ *Burst Catalog Entry*
 - ▶ *Spectral Catalog*



GBM SW Release Capabilities

► ***Instrument Operations & Data Analysis (IODA) Release 1***

- *Quicklook data Display*
- *Instrument Status Alerts*
- *I&T Support*

► ***IODA Release 2***

- *FSW Maintenance*
- *Command Load Handling*
- *Packet Data Handler: Level 0 -> Level 1, Science*
- *Burst Alert Processor*

► ***IODA Release 3***

- *Packet Data Handler: Level 0 -> Level 1, Housekeeping*
- *Calibration Archive*
- *Trigger Data Packager*
- *SC Position and Orientation History*
- *Trigger and Burst Catalogs (Level 2)*
- *GRB Flux, Fluence, Duration and Location*
- *Spectral Analysis Final*



GBM SW Schedule Details

<i>Milestone</i>	<i>Date</i>	<i>Driver</i>	<i>Date</i>
<i>Command and Telemetry Database (GSW Build 0.2)</i>	<i>June 28, 2004</i>	<i>GSIS Delivery (to SAI)</i>	<i>July 26, 2004 (TBR)</i>
<i>IODA Release 1 (release: end of verification)</i>	<i>Feb. 1, 2005</i>	<i>Ground Readiness Test (GRT) 1</i>	<i>Feb. 15, 2005</i>
<i>Build 1.1: Command and FSW Load Handling</i>	<i>Mar. 15, 2005</i>	<i>GRT 2</i>	<i>Apr. 15, 2005</i>
<i>IODA Release 2</i>	<i>May 31, 2005</i>	<i>GRT 3: Level 1 Science & Burst Alerts</i>	<i>June 15, 2005</i>
<i>Build 2.1: Burst Alert Processor</i>	<i>Aug. 1, 2005 (to GSSC)</i>	<i>GRT 4: Level 1 HK</i>	<i>Sept. 1, 2005</i>
<i>Build 2.2: CALDB & Trigger (Launch Ready)</i>	<i>Nov. 1, 2005 (to GSSC)</i>	<i>GRT 5, GBM Pre-Ship Review</i>	<i>Nov. 15, 2005</i>
<i>Build 2.3: DRM Generator</i>	<i>Dec. 1, 2005</i>	<i>Start of End to End (ETE) Tests</i>	<i>Feb. 8, 2006</i>
<i>IODA Release 3</i>	<i>Apr. 14, 2006</i>	<i>ETE 2</i>	<i>May 4, 2006</i>
<i>Build 3.1: DRM Database</i>	<i>Nov. 1, 2006</i>	<i>To support phase E</i>	<i>Post-launch</i>



SIM/DRM Delivery* Schedule

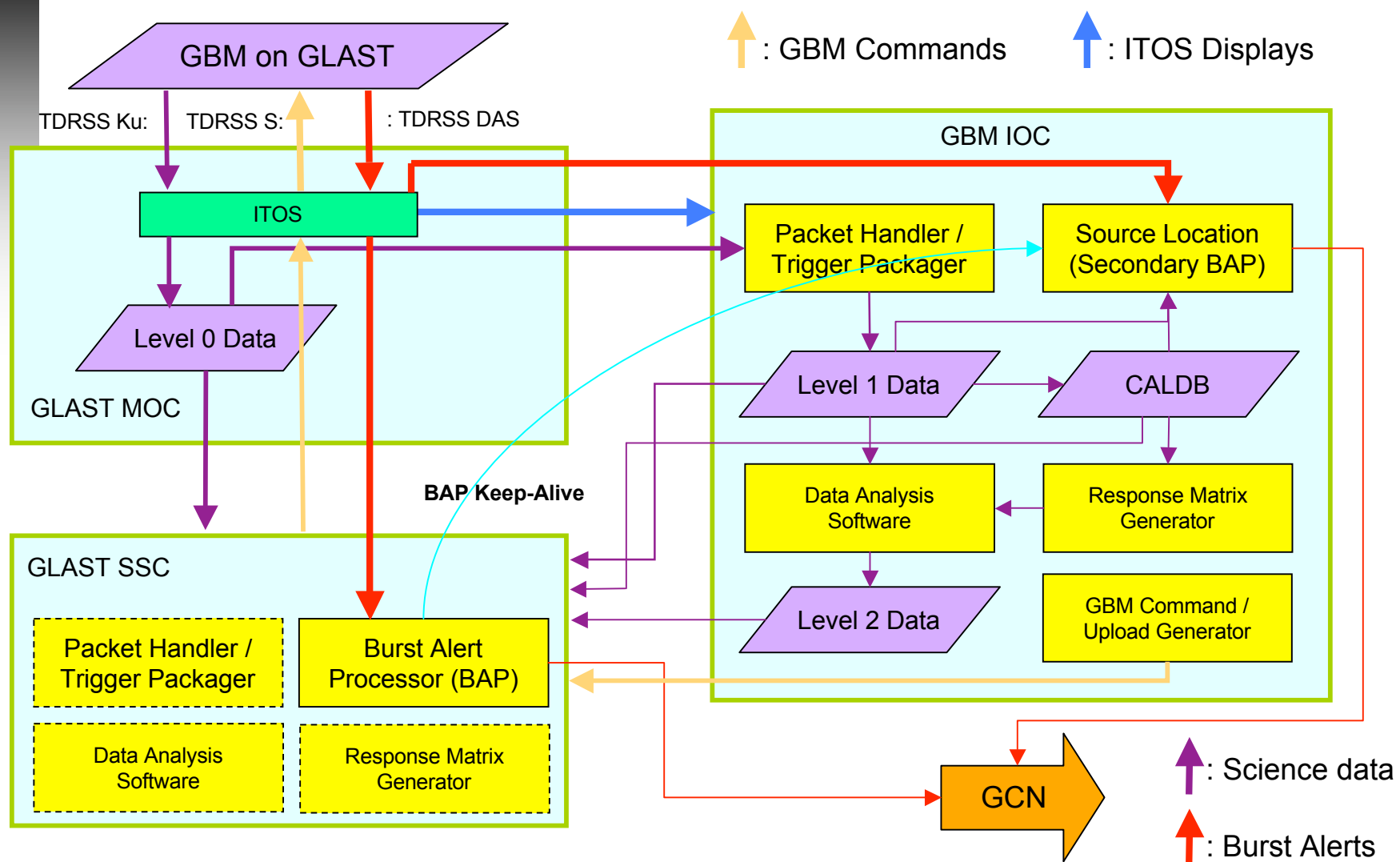
<i>Milestone</i>	<i>Date†</i>	<i>Driver</i>	<i>Date</i>
<i>SIM/DRM Delivery 1</i> <i>(Det.-level s/w & models)</i>	<i>Nov. 1, 2004</i> <i>(Δ+4 mo)</i>	<i>Verify s/w & models with GBM detector-level calibrations</i>	<i>Feb. 2005 – Mar. 2005</i>
<i>SIM/DRM Delivery 2</i> <i>(Syst.-level s/w & models)</i>	<i>Jun. 15, 2005</i> <i>(Δ+3 mo)</i>	<i>Verify s/w & models with GBM system-level calibrations</i>	<i>Jul. 2005 – Sep. 2005</i>
<i>SIM/DRM Delivery 2.1</i> <i>(preliminary CALDB/DRM)</i>	<i>Nov. 1, 2005</i> <i>(new)</i>	<i>Support IODA Builds 2.2 & 2.3</i>	<i>Nov. 1, 2005; Dec. 1, 2005</i>
<i>SIM/DRM Delivery 3</i> <i>(S/C-level s/w & models)</i>	<i>Jan. 2, 2006</i> <i>(Δ+3 mo)</i>	<i>Verify s/w & models with GBM spacecraft-level source survey</i>	<i>Feb. 2006</i>
<i>SIM/DRM Delivery 4</i> <i>(Ops. phase s/w & models)</i>	<i>Apr. 14, 2006</i> <i>(no change)</i>	<i>Support IODA Release 3</i>	<i>Sept. 1, 2005</i>
<i>SIM/DRM Delivery 5</i> <i>(Final DRM/CALDB database)</i>	<i>Nov. 1, 2006</i> <i>(no change)</i>	<i>Support Phase E science/Ops.</i>	<i>Post-launch</i>

* All deliveries from LANL to NSSTC

† Schedule changes from ground s/w CDR reflect changes in the GBM calibration schedule (affected by launch slip)



Revised Data Flow

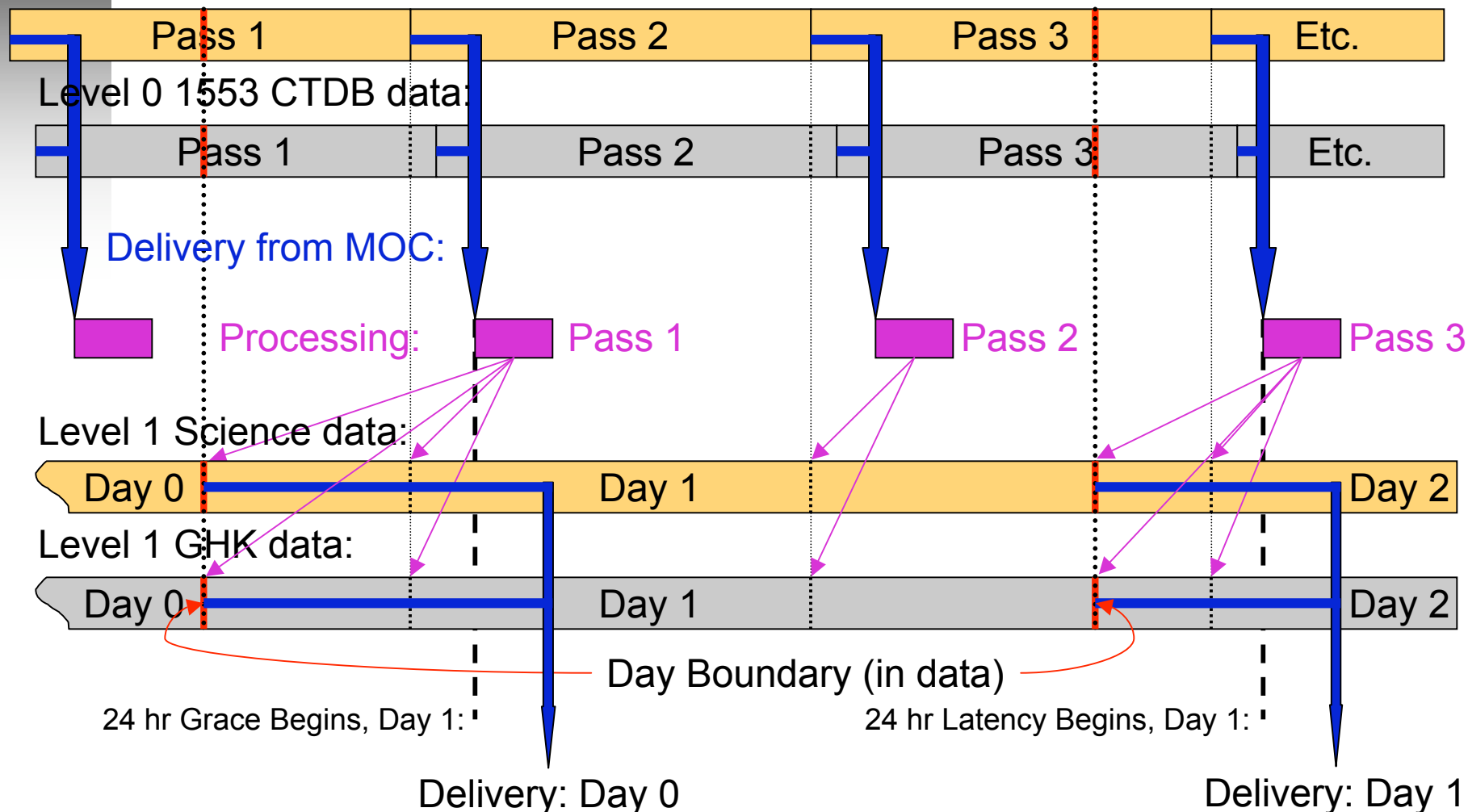




Data Flow Time Line - Continuous

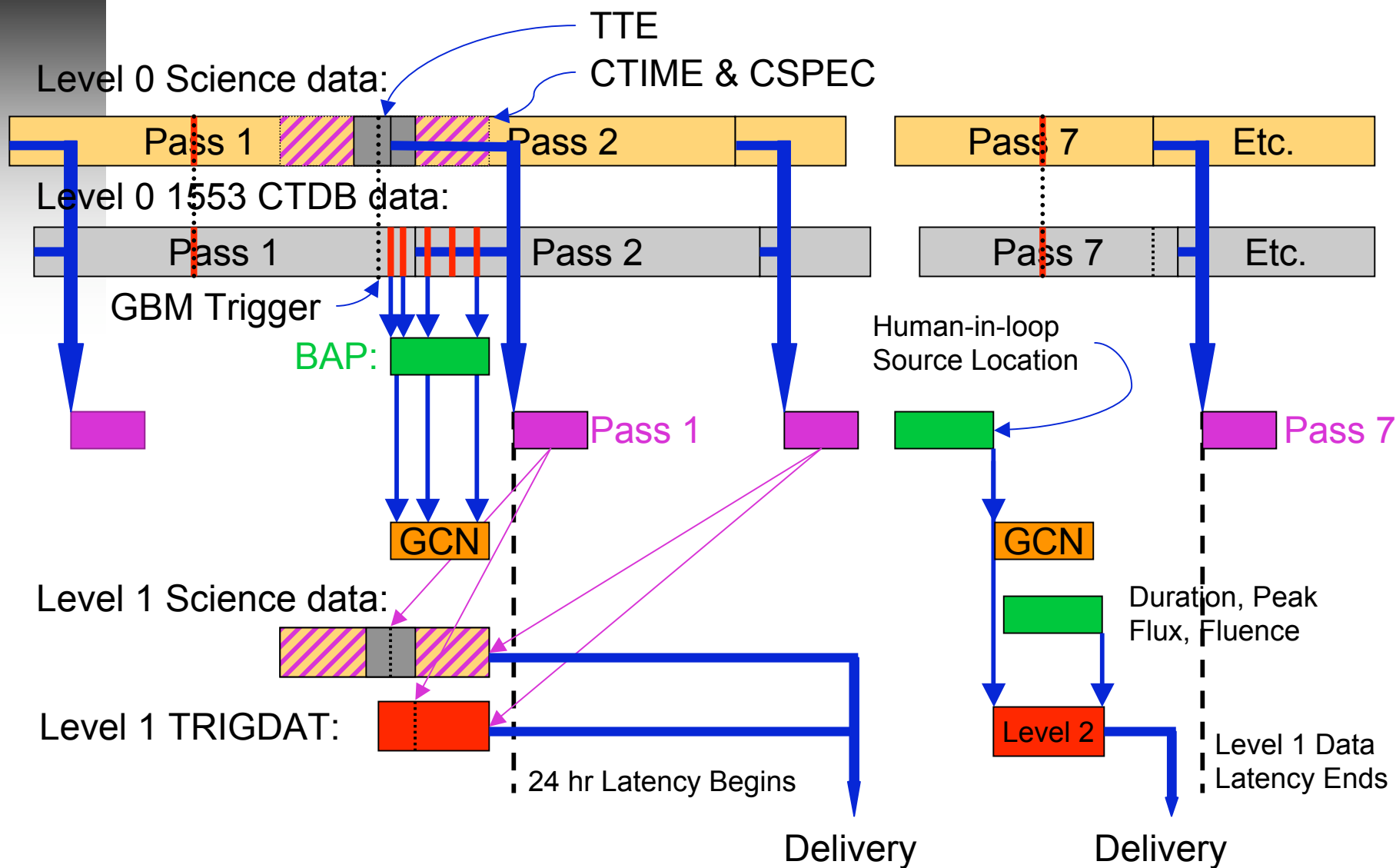


Level 0 Science data (6 - 8 Passes / day typical):





Data Flow Time Line - Trigger





Use of COTS

► **LabView:**

- *Basis for AstroRT*
- *Portable, scriptable, very high level*
- *Used for data displays in EGSE deployment phases*

► **IDL:**

- *Very portable (VM runs anywhere; free), high level, interactive*
- *Used for science data display in EGSE deployment phases*
- *Basis for science data analysis software: rmfit*

► **Perl:**

- *Scripting language for AstroRT*
- *Used for automated Instrument Operations & Data Analysis (IODA) tasks*

► **C / C++:**

- *Used for modular components in operations phase*
- *Portable, with proper makefile design*
- *Command-line tools (CLT) integrate well with perl*

► **ITOS / STOL:**

- *Used by MOC for T&C DB and basis for PROCs*
- *Used for data displays in operations phase*



Software Technical Process Plan

► **Process Model:**

- *Preliminary Design of each Build: Ground Software Lead*
- *Detailed design: Ground Software Lead*
- *Periodic design walk-throughs: Ground Software Design Team*
- *Informal code and test: Ground Software Lead*
- *Coding: Ground Software Lead*

► **Methods, Tools & Techniques:**

- *Software requirements analysis: GBM IODA Functional Specifications*
- *Ground Software design: GBM Ground Software Design Specification*
- *Initial Development: GBM EGSE (SIIS, running ASTRO-RT)*
- *Final delivery Ground Software*
 - *Relocatable Software Components*
 - *Modular objective elements & standard interface definitions*

► **Infrastructure Plan:**

- *Hardware OS: commercially-available UNIX (e.g.: Red Hat Linux)*
- *Development tools: standard distributions of Linux*



Supporting Process Plans

► **Configuration Management:**

- *GBM Ground Software configuration management: BitKeeper*
 - *Each component: separate Version Number*
 - *Version number: displayed on any generated output or data product*
 - *GBM Ground Software Documents: GBM Configuration Manager*
- *Archiving of Software builds: 2 copies by CD-R*
- *Changes to baselined products:*
 - ⇒ *Software Problem Report*
 - ⇒ *Software Review Board*
 - ⇒ *Configuration Manager baselines and maintains each new version*

► **GBM Ground Software Coding Standards:**

- *Subset of Indian Hill C Style (L. W. Cannon, et al.)*
- *C or C++ will be used where appropriate*
- *Other software languages may be imposed by circumstances (ASTRO-RT & ITOS)*
 - *Coding Standards will be applied as appropriate*
- *Reused and tested code need not be changed to accommodate standards*



Supporting Process Plans (Cont'd.)

► ***Verification and Validation, GBM Ground Software:***

- *Verification testing: GBM Ground Software Test Team*
 - *Independently: MPE GBM co-investigators*
 - *GBM IODA Functional Specifications: Verification Test Procedures*
 - *Initial verification testing: Hardware supporting GBM EGSE*
- *Validation: Final GIOC hardware configuration (GRTs)*
- *Revisions from verification: Software Problem Report*
 - *Ground Software Lead: SPR goes to GBM Ground Software Design Team*
 - *Suggested Resolution: SRB*
 - *SRB reports to IODA Lead for implementation, revisions & retesting*

► ***Documentation review: GBM Ground Software Design Team***

► ***Reviews and Audits:***

- *Monthly: GBM Ground Software Lead reports to GBM Ground System Manager*
- *Code Walkthroughs*
- *Informal: GBM Ground Software Software Design Team*
- *By Request: GBM PI & Ground System Manager*



Software Testing Concept

► **Software Test & Validation Levels**

– *Developer's Unit Verification*

- *Developer Performs & Documents Unit Testing Along Specifications*

– *Module/Executables Verification*

- *Test Team Specifies Test Plan with Test Cases*
- *Test Team Conducts and Documents Tests*
- *Developers Provide Deliverables*
- *"Modules":= Self-Contained Executable, Implementing a Set of Functions*

– *System Releases Validations*

- *Test Team Specifies Test Plan*
- *Test Team Conducts Release Integrity & Completeness Verification*
- *"Release":= System as Supporting GRTs as per schedule*

– *Ground System Validation*

- *Test Team Specifies Test Plan*
- *Test Team Conducts Release Integrity & Completeness Verification*
- *Objective is to Validate Interplay Among Different Installations*



Level of Effort Estimate (from CDR)



<i>Module Name</i>	<i>SLOC / Effort (BATSE or COTS)</i>	<i>Effort Mult.</i>	<i>SLOC / Effort (GBM)</i>
<i>Command Load Handling</i>	<i>AstroRT, ITOS</i>	<i>N/A</i>	<i>4 mo</i>
<i>SC Position and Orientation History</i>	<i>AstroRT, ITOS</i>	<i>N/A</i>	<i>3 mo (or 0?)</i>
<i>Packet Handler</i>	<i>12k / 2.8 yr</i>	<i>50%</i>	<i>6k / 16 mo</i>
<i>Instrument Status, Displays and Alerts</i>	<i>(ITOS), IDL</i>	<i>N/A</i>	<i>6 mo</i>
<i>Raw data display (AstroRT, ITOS, IDL)</i>	<i>7k / 1.5 yr</i>	<i>25%</i>	<i>1.7k / 4.5 mo</i>
<i>Source Location Software / BAP</i>	<i>7k / 1.6 yr</i>	<i>50%</i>	<i>3.5k / 9.5 mo</i>
<i>Calibration Archiver</i>	<i>4k / 10 mo</i>	<i>100%</i>	<i>4k / 10 mo</i>
<i>Trigger Packager</i>	<i>7.5k / 1.6 yr</i>	<i>25%</i>	<i>1.8k / 5 mo</i>
<i>Trigger Catalog Front End</i>	<i>IDL</i>	<i>N/A</i>	<i>5 mo</i>
<i>GRB Flux, Fluence, Duration (rmfit add-in)</i>	<i>25k / 6 yr</i>	<i>5%</i>	<i>1.2k / 3.5 mo</i>
<i>Spectral Analysis Final (rmfit)</i>	<i>25k / 6 yr</i>	<i>10%</i>	<i>2.5k / 7 mo</i>
<i>Total GBM Effort Estimate:</i>			<i>73 mo = 6 yr</i>



Contingency / Backup Scenarios

- ▶ *Level 0 data archive at MOC, GSSC (HEASARC)*
- ▶ *Level 1 backup archive at GSSC, MPE*
- ▶ *Level 1 processing pipeline backup at GSSC*
- ▶ *Secondary BAP at GIOG (5 s keepalive signal)*



SIM/DRM Risks

► (1) *Schedule*

- *Revised schedule for CY'2005 is now extremely tight since it includes deliveries/analysis in support of most calibrations, as well as delivery in support of IODA development.*
 - *Mitigate by using remainder of 2004 to complete as much software development as possible*

► (2) *Personnel*

- *Current lead developer (Andrew Hoover) has a limited-term postdoctoral position scheduled to expire in June 2005.*
 - *Mitigate by extending postdoc term for another year and/or hiring/training replacement*



Backup Slides

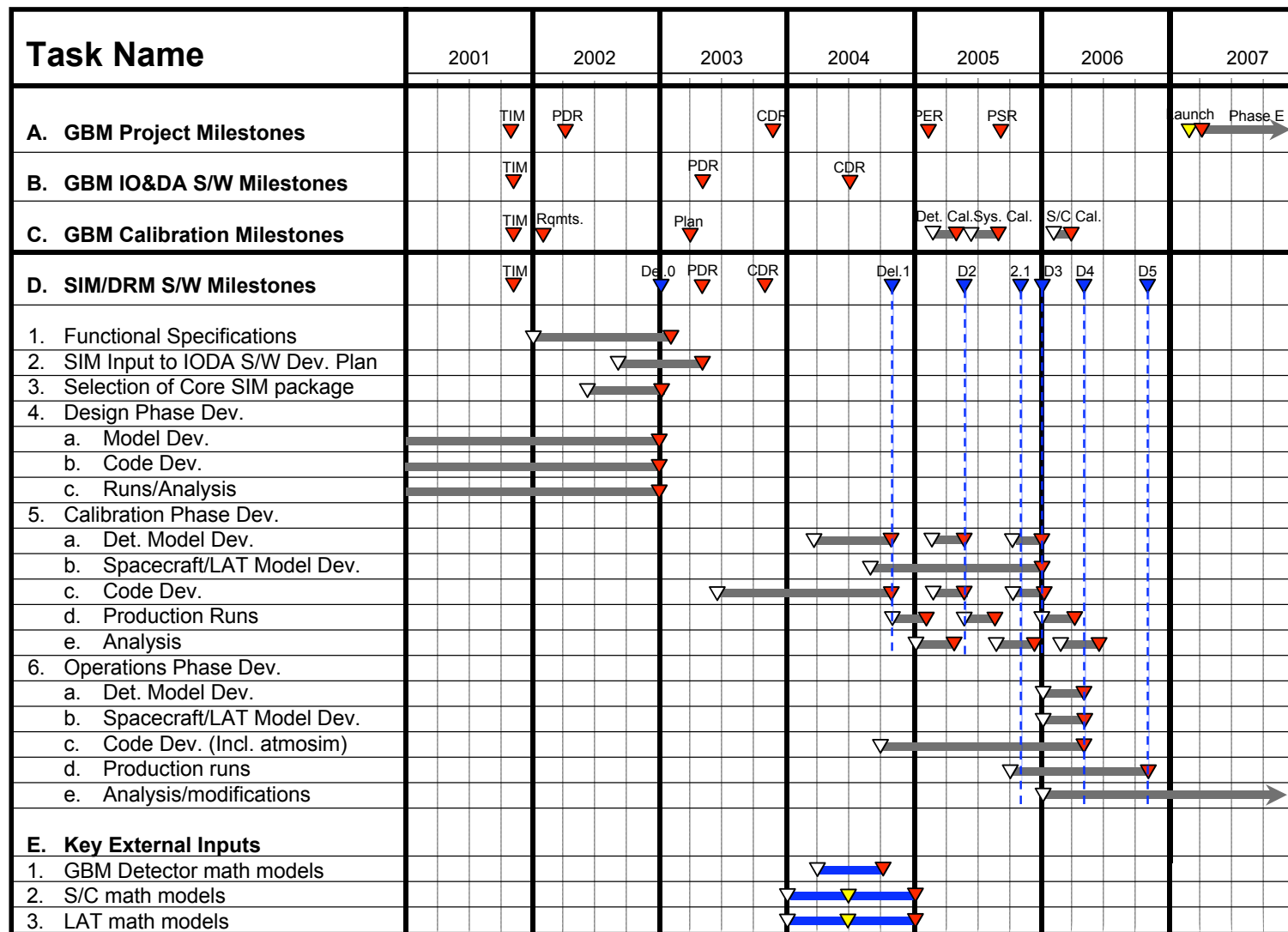


ITOS at the GIOC

- ▶ ***Considering supplemental use of ITOS; to help meet GSW requirements:***
- ▶ ***Useful for validating the T&C database***
- ▶ ***Useful for display of GHK during GBM I&T***
- ▶ ***Allows GIOC to check the FSW upload procedure early in the development process***
- ▶ ***Generation of Level 0 1553 CTDB data early helps GSW design effort***
- ▶ ***Display & Archive of GBM Level 0 Science data by ITOS awaits complete disclosure of LVDS downlink format by SAI***
- ▶ ***Data archiving by ITOS will be useful for I&T, GRT & E-E Tests***



SIM/DRM Detailed Schedule



06/22/04